

Executive Summary

Purpose

This Feasibility Study (FS) develops and evaluates remedial alternatives for mitigating soil and groundwater contamination at Environmental Restoration Program (ERP) Site LF-13 (Site 13) and adjacent ERP sites (2, 19, 20, and Area of Concern [AOC] 26). Collectively, Site 13 and adjacent ERP sites are referred to in this report as “the investigation area.”

The FS is one of several steps that comprise the Comprehensive Environmental Restoration, Compensation, and Liability Act (CERCLA) process. Although Beale Air Force Base (AFB or Base) is not on the National Priorities List, the Air Force implements the ERP in a manner consistent with CERCLA guidance and policy.

Prior to the development of this FS, a Remedial Investigation (RI), Human Health Risk Assessment (HHRA), and an Ecological Risk Assessment (EcoRA) were performed and are documented in the Site 13 RI (CH2M HILL, 2001a). The RI documented the presence of contamination and summarized site investigations and interim remedial actions in the investigation area. The risk assessments evaluated the increased risk to human health and ecological receptors posed by the contamination. A water resources assessment (WRA) was also conducted, and is included as part of the FS, to assess if contaminants have the potential to impact or have impacted water quality and/or threaten the beneficial uses of water resources. This FS uses the information presented in the RI, HHRA, EcoRA, and WRA to develop and evaluate alternatives for remedial action. The information presented in this FS will be used to help decisionmakers select the preferred remedy for mitigating contamination in the investigation area. The preferred remedy will be presented to the public in a Proposed Plan. After the public comments are received, the final selection will be documented in the Record of Decision (ROD).

Beale AFB History

Beale AFB has undergone several name changes since its establishment as “Camp Beale” in October 1942 by the U.S. Army. Camp Beale served as a training ground for infantry and armor units, a personnel deployment depot, a prisoner-of-war encampment, and was the site of a large military hospital. After World War II (WWII), Camp Beale was transferred to the Air Force. From 1948 to 1951, the Base was known as the “Beale Bombing and Gunnery Range” and was used for bombardier and navigator training. In 1951, the range was designated “Beale AFB,” and was under several jurisdictions, including the Air Training Command, the Aviation Engineering Force, and finally the Strategic Air Command. The first runway became operational in 1958. Recently, Beale AFB has been primarily associated with Air Force refueling and reconnaissance missions.

Site Setting

Beale AFB is located in Yuba County, California, approximately 40 miles north of Sacramento and 10 miles east of Marysville, as shown on Figure ES-1. The Site 13 investigation area is located in the southwestern corner of Beale AFB near the Wheatland Gate, north of J Street, near the wastewater treatment plant (Figure ES-2). Hutchinson Creek flows along its southern and western boundaries.

Topographic relief in the area of Site 13 is small, with ground surface generally sloping gently to the southwest. Much of the land around Site 13 is used for cattle grazing. The land adjacent to Beale AFB west of Site 13 is used primarily for rice farming, and is known as Deep Violet Farms.

Site Descriptions

A brief explanation of each site within the Site 13 investigation area is provided in this section, including suspected sources of contamination, site investigation activities, remedial actions, and type of contaminants.

Site 13

Site 13 encompasses inactive Landfill No. 1, which received waste until the mid-1950s. Debris disposed of in the landfill is thought to include domestic debris from nearby ranchers and farmers, solvents, Army personnel equipment, incinerator ash, Army personnel domestic debris, M-5 skin ointment tubes, and clarifier skimmings from the wastewater treatment plant. Primary contaminants at Site 13 are metals, petroleum hydrocarbons, chlorinated volatile organic compounds (VOC) and dioxins in soil, and chlorinated VOCs in groundwater.

Previous investigation activities at Site 13 include a Phase I Records Search, a Phase II, Stage 1 Confirmation/Quantification Study, a Stage 2-1 RI, and a Phase II, Stage 3 Preliminary Assessment/RI. Investigative techniques included geophysical survey, soil vapor survey, surface soil sampling, exploratory test pits, soil boring/HydroPunch® sampling, deep stratigraphic borings, installation and sampling of monitoring wells, and surface water and sediment sampling.

Remedial actions previously conducted include the following:

- Groundwater monitoring and provision of an alternative water supply source to Deep Violet Farms
- Groundwater extraction and treatment (Groundwater Treatability Test System [GTTS])
- Soil excavations, including the M-5 ointment-tube disposal cell and three incinerator ash disposal trenches
- Soil vapor extraction (Site 13 East and West soil vapor extraction [SVE] systems)

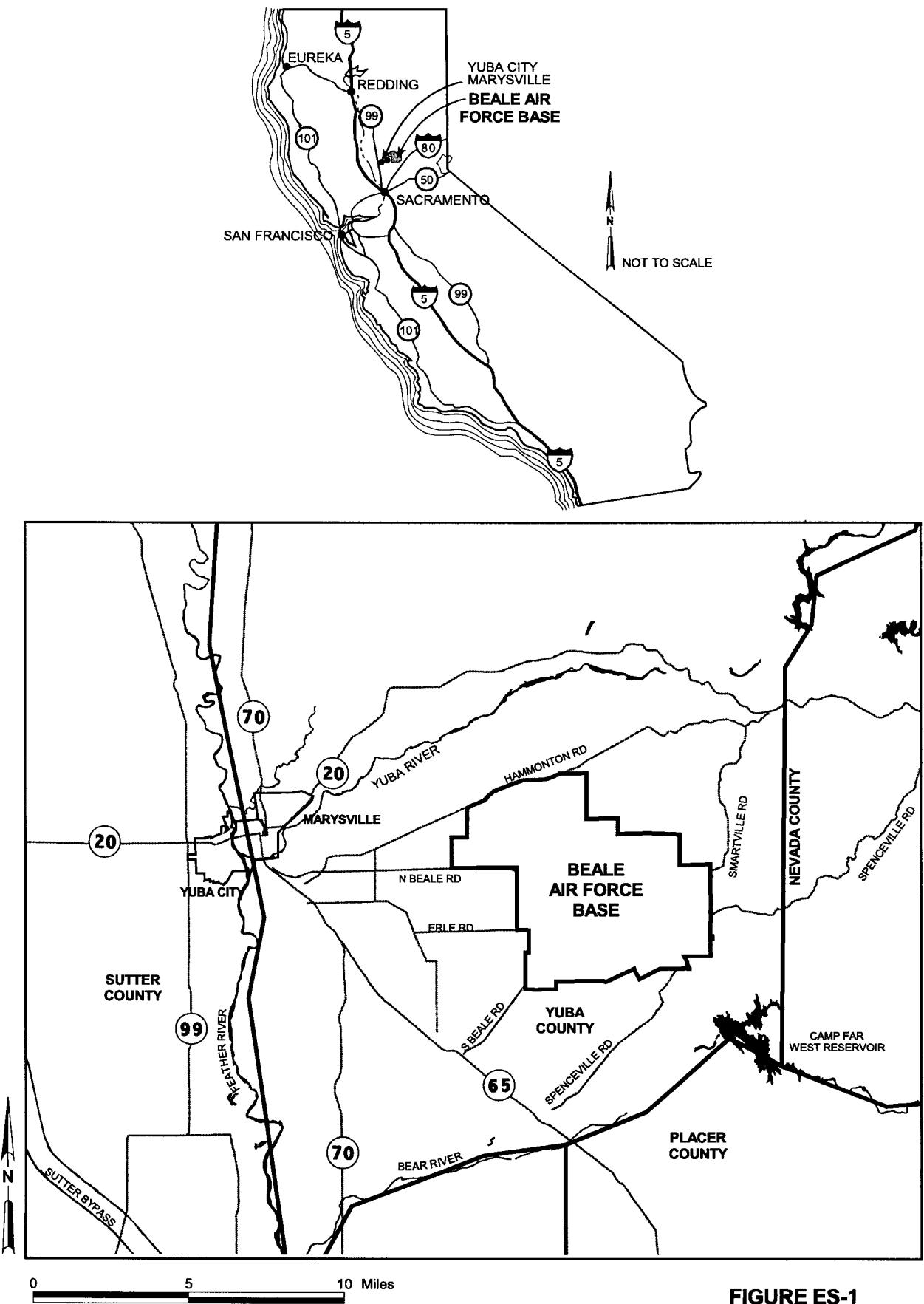


FIGURE ES-1
BEALE AIR FORCE BASE
LOCATION MAP
 SITE 13 FEASIBILITY STUDY
 BEALE AIR FORCE BASE, CALIFORNIA

CH2MHILL

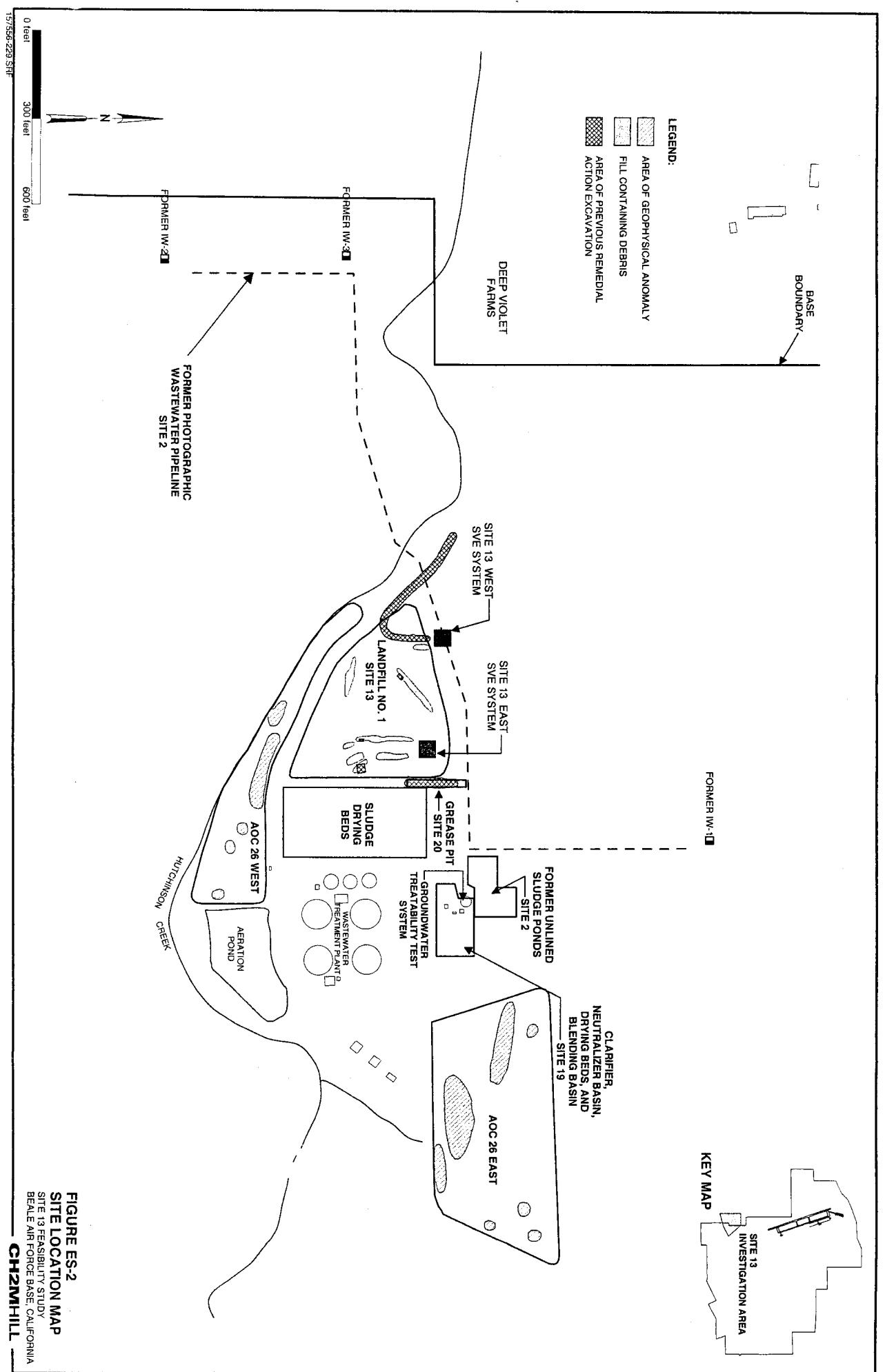


FIGURE ES-2
SITE LOCATION MAP
SITE 13 FEASIBILITY STUDY
BEALE AIR FORCE BASE, CALIFORNIA

Site 2

Site 2 comprises portions of the former Photographic Wastewater Treatment Plant (PWTP), which consisted of several facilities used for the transport, treatment, and disposal of wastewater from the photographic laboratory (Building 2145). Facilities included two unlined sludge ponds, sand and limestone filters, and filter surge tanks. The treated effluent pipeline was located above the ground and discharged to three injection wells (Figure ES-2).

The unlined sludge ponds and discharge of pentachlorophenol (PCP)-treated effluent onto the ground around the former PWTP and near the injection wells caused concern about contamination. PCP was periodically added to the wastewater to prevent organic growth and corrosion in the pipeline. Commercial-grade PCP typically contains contaminants including other polychlorinated phenols, dioxins, and furans. Primary contaminants include dioxins and furans in surface and subsurface soils.

Previous investigations at Site 2 include a Phase I Records Search; Phase II, Stage 1 investigation; Resource Conservation and Recovery Act inspection reports; Stage 2-1 RI; Stage 2 RI; and collection of sludge, soil, surface water, groundwater, and sediment samples. Remedial actions previously conducted include the following:

- Removal of sludge from the unlined sludge ponds
- PWTP filter dismantling and decontamination
- Effluent pipeline decontamination and dismantling
- Removal of the sludge pond berms and excavation of 2.5 feet of soil beneath the sludge ponds
- Excavation of soil around injection well 2 to a depth of 5 feet below ground surface
- Ongoing groundwater monitoring

In 1999, a No Further Response Action Planned (NFRAP) decision document for Site 2 was prepared by Radian International, Inc., (1999a) and approved in February 2000.

Site 19

Site 19 consisted of a portion of the PWTP treatment facility adjacent to Site 2 including a clarifier, neutralizer basin, drying beds, and blending basin. The photographic processing waste discharge contained significant metal concentrations, and until 1986, PCP was periodically added to the wastewater to prevent organic growth and corrosion in the pipeline. Primary contaminants in soil included dioxins and furans.

Previous investigations conducted at Site 19 include a Stage 2-1 RI, groundwater monitoring, and an expanded RI. Previous remedial actions at the site included the removal of the blending and neutralizer basins, clarifier, injection pump pit, and sludge dewatering beds near Site 2. Following removal actions, dioxin and furan concentrations in confirmation samples were below risk-based cleanup levels. The Air Force is in the process of preparing a NFRAP decision document for Site 19. Site 19 was not carried forward in the FS.

Site 20

Site 20, located northwest of the wastewater treatment plant (Figure ES-2), was an unlined grease pit or trench that received grease skimmings from the treatment plant clarifier. An aboveground storage tank later replaced the grease pit. Site 20 is no longer used, and the waste material has been excavated and backfilled with clean soil.

Previous investigations at Site 20 include an RI and a Phase II RI. Remedial actions at the site include the removal of liquids, sludge, and soil from the grease pit. A risk assessment was conducted to evaluate the potential effects to human health and the environment after remediation. No risks were identified. A NFRAP decision document was approved for Site 20 in February 2000. Site 20 was not carried forward in the FS because the NFRAP document was approved and no increased risk was associated with Site 20.

AOC 26

AOC 26 consists of two former WWII disposal areas located southwest and northeast of the wastewater treatment plant (Figure ES-2). Previous investigations at AOC 26 include a geo-physical survey, test pit excavations, a soil vapor survey, and soil sampling.

Low levels of VOCs were detected in all soil vapor samples; however, VOC contamination was not confirmed in soil samples. Pesticides, dioxins, furans, and metals were detected at low levels in soil samples collected from test pit excavations. No remedial actions have been conducted.

Media and Contaminants Requiring Remediation

The results of the HHRA, EcoRA, and WRA for the Site 13 investigation area were reviewed to develop a list of contaminants of concern (COC) by media that require remediation. A summary of affected media carried through for alternative development is presented in Table ES-1.

TABLE ES-1
Media and Contaminants Requiring Remediation
Site 13 Feasibility Study, Beale Air Force Base, California

Media that Exceed Criteria for Human Occupational Scenario		Media that Exceed Criteria for Ecological Risks		Media that Have the Potential to Impact Beneficial Uses of Groundwater	
Media	COCs	Media	COCs	Media	COCs
Landfill Soils	Metals, dioxin	Landfill Soils	Lead, zinc	Landfill Soils	VOCs and TPH-D ^a
Pipeline-affected Soil	Dioxin, furans	Pipeline-affected Soil	Dioxin	Groundwater	VOCs
Sludge Pond-affected Soil	Dioxin				

^aTPH-D = total petroleum hydrocarbons as diesel

The Feasibility Study Process

This FS identifies, evaluates, and compares cleanup methods (known as remedial alternatives) that could be used to mitigate soil and groundwater contamination in the Site 13 investigation area. The FS can be divided into the following three main phases:

1. Development of Preliminary Cleanup Goals
2. Development of Alternatives
3. Detailed Analysis of Alternatives

Phase 1 – Development of Preliminary Cleanup Goals

Remedial action objectives (RAO) in combination with a review of applicable or relevant and appropriate requirements (ARAR) guided the selection of numerical preliminary cleanup goals. Preliminary cleanup goals were developed to delineate the extent and volume of contaminated media, which is necessary when remedial alternatives are being evaluated and compared within the CERCLA FS process. Preliminary cleanup goals were developed for soil and groundwater to target the COCs requiring remediation.

Phase 2 – Development of Alternatives

Alternatives were developed for each affected medium to provide a range of options that vary primarily in the extent of active remediation and reliance on long-term management of residuals and untreated wastes. The objective of alternative development is to provide sufficient information to conduct a detailed analysis and comparison of alternatives. Alternatives were developed separately for each affected medium within the Site 13 investigation area (landfill soils, pipeline-affected soil, sludge pond-affected soil, and groundwater). This was done because the actions can be conducted relatively independently.

The development of alternatives is divided into the following five steps:

1. **Develop General Response Actions** – General response actions describe the broad range of actions that will satisfy RAOs. Examples of general response actions that may be used to achieve RAOs include land use controls, treatment, containment, excavation, and disposal.
2. **Identify Potential Remedial Technologies and Process Options** – Many potentially applicable technology types are available to remediate various categories of contaminants in all environmental media under various site conditions. General technology types that can be used to implement a general response action are referred to as “remedial technologies.” Specific technology types within a remedial technology are called “process options.” An example of a remedial technology for containment is capping; an example of a process option within this remedial technology is an engineered cap.
3. **Evaluate and Select Representative Technology Process Options** – Process options are evaluated for technical implementability, effectiveness, and cost. During the evaluation, process options or entire technologies may be dropped from further review. From the list of remaining process options within each remedial technology, a representative process option is selected. The representative process option is used to develop the

alternatives, but the other equally promising process options are retained, giving decisionmakers more flexibility in the future when the selected remedial action is designed.

4. **Assemble Remedial Alternatives** – The representative process options are used to assemble remedial alternatives that represent a range of general response actions for the individual media. An additional step of screening the remedial alternatives may be implemented to reduce the number of alternatives if necessary. Screening of alternatives was not conducted for this FS.
5. **Develop Remedial Alternatives** – In this step, the alternatives that were assembled are further developed. This step provides a conceptual-level design that enables costs to be developed and the alternatives to be evaluated.

Phase 3 – Detailed Analysis of Alternatives

In this phase of the FS, alternatives are evaluated in detail against the standard criteria provided under CERCLA. The seven criteria used in the detailed analysis are listed below:

1. Overall protection of human health and the environment
2. Compliance with ARARs
3. Long-term effectiveness and permanence
4. Reduction of toxicity, mobility, or volume through treatment
5. Short-term effectiveness
6. Implementability
7. Cost

Alternatives will be evaluated against two additional criteria, state acceptance and community acceptance, after public comment on the FS and the Proposed Plan.

The alternatives are evaluated individually against each criterion, and then the different alternatives developed for an affected medium are compared to determine specific strengths and weaknesses that must be balanced. The results of the detailed analysis support the selection of a remedial action and the foundation for the ROD.

Remedial Action Objectives

RAOs can be divided into two categories: general and specific. General RAOs may be applied to all sites; specific RAOs reflect site-specific conditions.

Preliminary General Remedial Action Objectives for Remedial Actions in the Site 13 Investigation Area

The general RAOs for remedial actions at Site 13 include the following:

- Protect human health and the environment by reducing the risk of potential exposure to contaminants
- Expedite site cleanup and restoration

- Restore contaminated sites to the extent necessary to support existing and proposed land uses
- Achieve compliance with ARARs

Preliminary Specific Remedial Action Objectives for Remedial Actions in the Site 13 Investigation Area

The specific RAOs for groundwater at Site 13 follow:

- Continue containment of the groundwater to minimize further migration of contaminants
- Restore groundwater quality to support its designated beneficial uses
- Protect human health by preventing exposure to contaminants in groundwater that would exceed water quality criteria for potential sources of drinking water
- Reduce groundwater contamination to cleanup standards in a cost-effective and timely manner

The specific RAOs for soil at Site 13 follow:

- Protect human health by preventing exposure to contaminants in soils that would result in an excess lifetime cancer risk greater than 1×10^{-6} or a hazard index greater than 1.0 for an occupational exposure scenario
- Protect ecological receptors from exposure to contaminants in soils that pose a significant risk
- Remove contaminants from the vadose zone to the extent technically and economically feasible to protect groundwater and to reduce cost and time of groundwater cleanup
- Prevent the migration of contaminants from soil to groundwater at concentrations that would cause groundwater to exceed ARARs or risk-based remediation goals

Overview of Alternatives

Remedial alternatives were developed by assembling remedial technologies and representative process options identified and screened in previous phases of the FS process. Remedial alternatives for the Site 13 investigation area were developed for the contaminants and media identified in Table ES-1 as requiring remediation.

Table ES-2 summarizes the remedial alternatives developed for each affected medium within the investigation area, including a brief description of the components.

Evaluation of Alternatives

Remedial alternatives developed and presented in Table ES-2 have been evaluated as part of Section 5.0, Detailed Analysis of Alternatives. Tables ES-3 through ES-6 summarize the results of the detailed analysis for landfill soils, pipeline-affected soil, sludge pond-affected soil, and groundwater, respectively.

The Final Decisions

The preferred remedial alternatives for soil and groundwater will be selected and presented in the Proposed Plan. This FS provides the information the public needs in order to understand and comment on the merits of the preferred alternatives. A public meeting will be held to formally present the preferred alternatives and to obtain public comment on them. After the public comments are received, the final plan will be issued in the ROD, a legal document that details the actions to be taken at the site.

TABLE ES-2
Summary of Remedial Alternatives for Site 13 Investigation Area
Site 13 Feasibility Study, Beale Air Force Base, California

Media	Alternative	Components	Description
Landfill Soils (LF)	LF-1	No Action	Perform no active remediation or monitoring.
	LF-2	Land Use Controls Continued Operation of the West SVE System Monitored Natural Attenuation (MNA)	Implement land use restrictions and site controls to limit direct contact of humans with contaminated soil. Continue operation of the West SVE system to remediate VOC contamination and MNA to address residual petroleum hydrocarbon contamination in vadose zone soil.
	LF-3	Soil Cover Land Use Controls Continued Operation of the West SVE System and MNA	Construct a soil cover to limit direct contact of human and ecological receptors with contaminated soil, improve runoff, and eliminate ponding in landfill area. Implement land use restrictions designed to protect the integrity of the soil cover. Continue operation of the West SVE system to remediate VOC contamination and MNA to address residual petroleum hydrocarbon contamination in vadose zone soil.
Pipeline-affected Soil (PL)	PL-1	No Action	Perform no active remediation or monitoring.
	PL-2	Land Use Controls	Implement land use restrictions and site controls to limit direct contact of humans with contaminated soil.
	PL-3	Soil Cover Land Use Controls Excavation and Offsite Disposal	Construct a soil cover over contaminated soil along the former PWTP effluent pipeline that poses a risk to human or ecological receptors. Implement land use restrictions to protect the integrity of the soil cover. Excavate contaminated soil along the former PWTP effluent pipeline with dioxin concentrations above the preliminary cleanup goal based on the occupational scenario. Dispose of excavated soil in an offbase landfill.
	PL-4	Land Use Controls	Implement land use controls to restrict residential use of areas with residual soil contamination that pose an increased risk to humans under the residential scenario.
Sludge Pond-affected Soil (SP)	SP-1	No Action	Perform no active remediation or monitoring.
	SP-2	Land Use Controls	Implement land use restrictions and site controls to limit direct contact of humans with contaminated soil.
	SP-3	Excavation and Offsite Disposal Land Use Controls	Excavate contaminated in the location of the former sludge ponds that contains dioxin concentrations above the preliminary cleanup goal based on the occupational scenario. Dispose of excavated soil in an offbase landfill. Implement land use controls to restrict residential use of areas with residual soil contamination that pose an increased risk to humans under the residential scenario.
Groundwater (GW)	GW-1	No Action	Perform no active remediation or monitoring.

TABLE ES-2
Summary of Remedial Alternatives for Site 13 Investigation Area
Site 13 Feasibility Study, Beale Air Force Base, California

Media	Alternative	Components	Description
	GW-2	Pump and Treat	Continue operation of the existing GTTS at current extraction rates. This alternative is divided into four subalternatives to achieve cleanup goals for the pump and treat system ^a .
		Alternative GW-2a – Pump and Treat with Cleanup Goal of 5 micrograms per liter ($\mu\text{g/L}$) trichloroethylene (TCE)	Alternative GW-2b – Pump and Treat with Cleanup Goal of 1.6 $\mu\text{g/L}$ TCE
		Alternative GW-2c – Pump and Treat with Cleanup Goal of 0.8 $\mu\text{g/L}$ TCE	Alternative GW-2d – Pump and Treat with Cleanup Goal of 0.5 $\mu\text{g/L}$ TCE
		Land Use Controls	Implement groundwater use restrictions to prohibit groundwater use in the areas exceeding cleanup goals. Perform long-term groundwater monitoring. Install additional monitoring wells to improve delineation of contaminant plume.
	GW-3	Enhanced Pumping to Accelerate Cleanup of Offbase Contamination	Continue operation of the existing GTTS with enhanced pumping near the Base boundary. As with Alternative GW-2, this alternative is divided into four subalternatives (GW-3a, 3b, 3c, and 3d) to achieve cleanup goals for the pump and treat system (5, 1.6, 0.8, and 0.5 $\mu\text{g/L}$ TCE, respectively).
		Land Use Controls	Implement groundwater use restrictions to prohibit groundwater use in the areas exceeding cleanup goals. Perform long-term groundwater monitoring. Install additional monitoring wells to improve delineation of contaminant plume.
	GW-4	Enhanced Pumping in Source Zone	Continue operation of the existing GTTS with enhanced pumping in the source area. As with Alternative GW-2, this alternative is divided into four subalternatives (GW-4a, 4b, 4c, and 4d) to achieve cleanup goals for the pump and treat system (5, 1.6, 0.8, and 0.5 $\mu\text{g/L}$ TCE, respectively).
		Land Use Controls	Implement groundwater use restrictions to prohibit groundwater use in the areas exceeding cleanup goals. Perform long-term groundwater monitoring. More monitoring wells would be needed for this alternative compared with Alternatives GW-2 and GW-3 for adequate source zone characterization.
	GW-5	Reductive Dechlorination in Source Zone	Continue operation of the existing GTTS with reductive dechlorination and bioaugmentation to reduce high dissolved TCE concentrations in the source area. As with Alternative GW-2, this alternative is divided into four subalternatives (GW-5a, 5b, 5c, and 5d) to achieve cleanup goals for the pump and treat system (5, 1.6, 0.8, and 0.5 $\mu\text{g/L}$ TCE, respectively).
		Land Use Controls	Implement groundwater use restrictions to prohibit groundwater use in the areas exceeding cleanup goals. As with Alternative GW-4, more monitoring wells would be needed for this alternative compared with Alternatives GW-2 and GW-3 for adequate source zone characterization.

^aSource of cleanup goals: 5 $\mu\text{g/L}$: Maximum Contaminant Level (MCL)

1.6 $\mu\text{g/L}$: Environmental Protection Agency Region IX Preliminary Remediation Goal

0.8 $\mu\text{g/L}$: California Office of Environmental Health Hazard Assessment Public Health Goal

0.5 $\mu\text{g/L}$: Method Detection Limit

TABLE ES-3
Landfill Soils (LF) Comparative Analysis Matrix
Site 13 Feasibility Study, Base Air Force Base, California

Remedial Alternative	Major Components	Threshold Criteria						Balancing Criteria	Estimated Net Present Value/Total Cost (\$)
		Protection of Health and the Environment	Compliance with ARARs	Long-term Effectiveness and Permanence	Reduction in Toxicity, Mobility, or Volume	Short-term Effectiveness	Implementability		
Alternative LF-1: No Action		C – RAOs would not be achieved. Carcinogenic risk for occupational use exceeding 10 ⁻⁶ maintained. High risk to ecological receptors. Does not reduce potential impacts of VOCs to groundwater.	C – Would not comply with ARARs requiring protection of the beneficial uses of groundwater.	C – Residual risk would not be diminished.	C – No treatment or reduction in TMV for metals, dioxin, or chlorinated VOCs. Toxicity and volume of residual petroleum contamination expected to occur by natural degradation.	C – No remedial action; therefore, no additional impacts to populations from implementation. RAOs would not be achieved.	A – Implementable.	0/0	
Alternative LF-2: Land Use Controls	Continued Operation of Existing SVE System and MNA	B – Controls human exposure to site contamination. Does not limit exposure to terrestrial invertebrates or terrestrial plants. SVE system and MNA would limit potential impacts of vadose zone contamination to groundwater.	A – Complies with ARARs. SVE system would prevent further degradation of groundwater by reducing concentrations that would result in exceedance of the MCL. The existing SVE system complies with action-specific ARARs.	B – Residual risk to human receptors would not be diminished; however, receptors would have limited access to contaminants. Residual risks to ecological receptors would remain. Residual risk to groundwater would be diminished using SVE system and MNA.	B – No treatment or reduction in TMV for metals or dioxin contamination. Would reduce TMV of VOC and petroleum contamination in vadose zone soil.	B – Installation of fences would require worker protection using adequate PPE. Provides for immediate access and use restrictions. No modifications to the SVE system would be required, and remediation would occur uninterrupted. RAOs for protection of ecological receptors would not be achieved.	A – Implementable. Base policies would allow for implementation of land use restrictions. SVE system is in place and currently operating. Semi-annual field monitoring at the Site 13 East SVE system is already occurring.	580,000/750,000	
Alternative LF-3: Soil Cover	Land Use Controls	A – Limits human and ecological exposure to site contamination. SVE system and MNA would limit potential impacts of vadose zone contamination to groundwater.	A – Complies with ARARs. SVE system would prevent further degradation of groundwater by reducing concentrations that would result in exceedance of the MCL. The existing SVE system complies with action-specific ARARs.	A – Residual risk of metal and dioxin contamination would not be diminished. However, would be effective at limiting human and ecological receptor exposure to contaminants with cap maintenance. Residual risk to groundwater would be diminished using SVE system and MNA.	B – No treatment or reduction in TMV of metals or dioxin contamination. Would reduce TMV of VOC and petroleum contamination in vadose zone soil.	A – Risk to the community, remedial workers, onsite workers, and the environment from dust and noise generated during soil covering would be minimized by appropriate controls and protective measures. Disturbed seasonal wetlands are present in the area that would be covered, and mitigation or other compensatory actions may be required. RAOs would be achieved rapidly.	A – Implementable; soil cover technology is considered reliable, equipment and technology are available. Base policies would allow for implementation of land use restrictions. SVE system is in place and currently operating. Semi-annual field monitoring at the Site 13 East SVE system is already occurring.	2,400,000/2,800,000	

Notes:

TMV = Toxicity, mobility, or volume
MNA = Monitored natural attenuation
PPE = Personal protective equipment

Qualitative assessment of the results of criteria evaluation:

- A – Favorable
- B – Favorable with qualifiers
- C – Not favorable

TABLE ES-4
Pipeline-affected Soil (PL) Comparative Analysis Matrix
Site 13 Feasibility Study, Beale Air Force Base, California

Remedial Alternative	Major Components	Threshold Criteria						Balancing Criteria
		Protection of Health and the Environment	Compliance with ARARs	Long-term Effectiveness and Permanence	Reduction in Toxicity, Mobility, or Volume	Short-term Effectiveness	Implementability	
Alternative PL-1: No Action	C – RAOs would not be achieved. Carcinogenic risk for occupational use exceeding 10 ⁻⁶ maintained. High risk to small mammals.	A – No chemical-, action-, or location-specific ARARs are applicable.	C – Residual risk would not be diminished.	C – No treatment or reduction in TMV.	C – No remedial action; therefore, no additional impacts to populations from implementation. RAOs would not be achieved.	A – Implementable.	0/0	
Alternative PL-2: Land Use Controls	B – Controls human exposure to site contamination. Does not limit exposure to small mammals.	A – No chemical-, action-, or location-specific ARARs are applicable.	B – Residual risk to human receptors would not be eliminated; however, risk would be controlled using land use restrictions. Risks to ecological receptors would not be diminished.	C – No treatment or reduction in TMV of dioxin contamination.	B – Installation of fences would require worker protection using adequate PPE. Provides for immediate access and use restrictions. RAOs for protection of ecological receptors would not be achieved.	A – Implementable. Base policies would allow for implementation of land use restrictions.	150,000/250,000	
Alternative PL-3: Soil Cover	Soil Cover Land Use Controls	A – Limits human and ecological exposure to site contamination by covering contaminated soil and implementing land use controls.	A – Complies with ARARs. Installation of a soil cover would comply with action- and location-specific ARARs.	A – Residual risk of dioxin contamination would not be eliminated. However, risk to human and ecological receptors would be controlled, provided the soil cover is maintained.	C – No treatment or reduction in TMV of dioxin contamination.	A – Risk to the community, remedial workers, onsite workers, and the environment from dust and noise generated during soil covering would be minimized by appropriate controls and protective measures. RAOs would be achieved rapidly.	320,000/420,000	
Alternative PL-4: Excavation and Offsite Disposal	Land Use Restrictions	A – Eliminates risk to future onbase workers or ecological receptors by removing soil and disposing in engineered cells at an offbase landfill. Carcinogenic risk would exceed 1 × 10 ⁻⁷ for the residential scenario, requiring limited land use controls to restrict residential use.	A – Complies with ARARs. Excavation and disposal would comply with chemical-, action-, and location-specific ARARs.	A – Excavation and offsite disposal would provide effective and permanent reduction of risk to onbase workers and ecological receptors. Residual risks to onbase residents would be controlled with land use restrictions.	A – TMV of pipeline-affected soil would be permanently reduced through excavation and offsite disposal.	A – Risk to the community, remedial workers, onsite workers, and the environment from dust and noise generated during excavation would be minimized by appropriate controls and protective measures. Minimal risk to the public from onsite transportation of hazardous waste. RAOs would be achieved rapidly.	720,000/730,000	

Notes:

Qualitative assessment of the results of criteria evaluation:

A – Favorable

B – Favorable with qualifiers

C – Not favorable

TABLE ES-5
Sludge Pond-affected Soil (SP) Comparative Analysis Matrix
Site 13-Feasibility Study, Beale Air Force Base, California

Remedial Alternative	Major Components	Threshold Criteria				Balancing Criteria	
		Protection of Health and the Environment	Compliance with ARARs	Long-term Effectiveness and Permanence	Reduction in Toxicity, Mobility, or Volume	Short-term Effectiveness	Implementability
Alternative SP-1: No Action		C – RAOs would not be achieved. Carcinogenic risk for occupational use exceeding 10^{-6} maintained. No risk identified to ecological receptors.	A – No chemical- action-, or location-specific ARARs are applicable.	C – Residual risk would not be diminished.	C – No treatment or reduction in TMV.	C – No remedial action; therefore, no additional impacts to populations from implementation. RAOs would not be achieved.	A – Implementable.
Alternative SP-2: Land Use Controls	Land Use Controls	A – Controls human exposure to site contamination. No risk identified to ecological receptors.	A – No chemical- action-, or location-specific ARARs are applicable.	A – Residual risk to humans however, risk would be controlled using land use restrictions.	B – No treatment or reduction in TMV for dioxin contamination.	A – Provides for immediate use restrictions. RAOs would be achieved rapidly.	A – Implementable. Base policies would allow for implementation of land use restrictions.
Alternative SP-3: Excavation Offsite Disposal	Excavation Offsite Disposal Land Use Restrictions	A – Eliminates risk to future onbase workers by removing soil and disposing in engineered cells at an offbase landfill. Carcinogenic risk would exceed 1×10^{-6} for the residential scenario, requiring limited land use controls to restrict residential use.	A – Complies with ARARs. Excavation and disposal would comply with chemical- and location-specific ARARs.	A – Excavation and offsite disposal would provide effective and permanent reduction of risk to onbase workers. Residual risks to hypothetical residents would be controlled with land use restrictions.	A – TMV of sludge pond- affected soil would be permanently reduced through excavation and offsite disposal.	A – Risk to the community, remedial workers, onsite workers, and the environment from dust and noise generated during excavation would be minimized by appropriate controls and protective measures. Minimal risk to the public from offsite transportation of hazardous waste. RAOs would be achieved rapidly.	A – Implementable; excavation technology is considered reliable, equipment and technology are available.

Notes:
Qualitative assessment of the results of criteria evaluation:

- A – Favorable
- B – Favorable with qualifiers
- C – Not favorable

TABLE ES-6
Groundwater (GW) Comparative Analysis Matrix
Site 13 Feasibility Study, Beale Air Force Base, California

Remedial Alternative	Major Components	Threshold Criteria				Balancing Criteria	Estimated Net Present Value/Total Cost (\$)
		Protection of Health and the Environment	Compliance with ARAFs	Long-term Effectiveness and Performance	Reduction in Toxicity, Mobility, or Volume		
Alternative GW-1: No Action		C - RAOs would not be achieved. Human exposure to contaminated groundwater would not be controlled. Contaminated groundwater would not be contained and could affect other groundwater resources.	C - Would not comply with ARAFs requiring restoration of the beneficial uses of groundwater and prevention of further degradation of high-quality groundwater. Would not fulfill groundwater monitoring requirements.	C - Residual risk would not be diminished.	C - No treatment processes. Reduction in TMV would occur by natural degradation, but would not achieve RAOs.	A - Implementable.	0/0
Alternative GW-2: Pump and Treat Pump and Treat Restrictions Groundwater Monitoring		A - Risks to human health and the environment would be controlled. Significant time would be required to achieve concentrations in groundwater protective of human health and the environment without requiring land use controls or monitoring. Protective values of human health and environment decreases with less stringent cleanup goals.	B - Existing GTTS designed to comply with all chemical- and action-specific ARAFs. Monitoring requirements fulfilled. Development of subalternatives compiles with numerical and narrative ARAFs.	B - Existing GTTS captures plume to nondetect. Uncertainty exists on whether groundwater pump and treat would attain cleanup goals in reasonable time frame. More stringent cleanup goals would be increasingly difficult to attain. Long-term management would be required including maintenance or replacement of GTTS system.	B - Plume is contained using existing GTTS system. Toxicity and volume of extracted groundwater reduced by aboveground treatment. Cleanup goals may not be achieved in areas of high concentrations, and the volume and toxicity of the groundwater would not be fully reduced.	B - Potential risks to the community, workers, and the environment during remediation of remedial actions would be mitigated. Significant time to achieve cleanup goals and associated RAOs.	C - No remedial action; therefore, no additional impacts to populations from implementation. RAOs would not be achieved.
Alternative GW-3: Enhanced Pump and Treat Pumping to Accelerate Cleanup of Offbase Contamination		A - Risks to human health and the environment would be controlled. Potential risks of offbase contamination would be further mitigated by reducing time to cleanup of distal portion of plume.	A - GTTS designed to comply with all chemical- and action-specific ARAFs. Monitoring requirements fulfilled. Development of subalternatives compiles with numerical and narrative ARAFs.	B - Existing GTTS captures plume to nondetect. Uncertainty exists on whether groundwater pump and treat would achieve cleanup goals in reasonable time frame.	B - Plume is contained using existing GTTS system. Toxicity and volume of extracted groundwater reduced by aboveground treatment. Cleanup goals may not be achieved in areas of high concentrations, and the volume and toxicity of the groundwater would not be fully reduced.	A - Potential risks to the community, workers, and the environment during implementation of remedial actions would be mitigated. Enhanced pumping in the distal portion of the plume would provide greater protection of the off-base community during implementation of the remedial action.	A - Implementable. Would require modifications to GTTS. May require installation of new extraction wells if existing wells cannot sustain higher flow rates.
Alternative GW-4: Enhanced Pump and Treat Pumping in the Source Zone		A - Risks to human health and the environment would be controlled. Risks would be further mitigated by increased pumping and mass removal in source zone.	A - GTTS designed to comply with all chemical- and action-specific ARAFs. Monitoring requirements fulfilled. Development of subalternatives compiles with numerical and narrative ARAFs.	B - Existing GTTS captures plume to nondetect. Source zone treatment would accelerate cleanup of the source area, but would not address limitations associated with pump and treat system.	A - Plume is contained using existing GTTS system. Source zone treatment would further reduce volume and toxicity of contaminated groundwater aquifer.	B - Potential risks to the community, workers, and the environment during implementation of remedial actions would be mitigated.	3a - 7,300,000/14,000,000 3b - 7,300,000/14,000,000 3c - 8,300,000/21,000,000 3d - 8,300,000/21,000,000 Contingency capital cost (new extraction wells) - 120,000
Alternative GW-5: Reductive Dechlorination in the Source Zone		A - Risks to human health and the environment would be controlled. Risks could be further mitigated by rapid dechlorination in source zone.	A - GTTS designed to comply with all chemical- and action-specific ARAFs. Monitoring requirements fulfilled. Development of subalternatives compiles with numerical and narrative ARAFs.	A - Existing GTTS captures plume to nondetect. Source zone treatment could increase likelihood that pump and treat would achieve cleanup goals within projected cleanup times.	A - Plume is contained using existing GTTS system. Source zone treatment could further reduce volume and toxicity of contaminated groundwater in aquifer.	B - Would require analysis of flow regime to ensure capture of plume during injection periods. Would require consultation to ensure injection of donor or microbial consortia would not impact beneficial uses of groundwater.	A - Implementable. Would require installation of two source zone extraction wells and additional modifications to GTTS.

Notes:
Qualitative assessment of the results of criteria evaluation:
A - Favorable
B - Favorable with qualifiers
C - Not favorable

